



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

February 1, 2001

CHAIRMAN

The Honorable Edward J. Markey
United States House of Representatives
Washington, D.C. 20515

Dear Congressman Markey:

I am responding to your letter of December 20, 2000, in which you asked several questions concerning the accountability for two irradiated fuel rods presumed missing from the Millstone Nuclear Power Station, Unit 1 (Millstone 1). Our responses to your specific questions are enclosed. Please recognize that we are early in our review of this event and are still pursuing clarification of a number of issues. The answers we are providing are based on our current knowledge. The licensee is continuing its investigation and we will continue to monitor its actions. As you requested, a copy of the Licensee Event Report, dated January 11, 2001, is provided, including a time-line of the licensee's actions leading to the discovery of the condition.

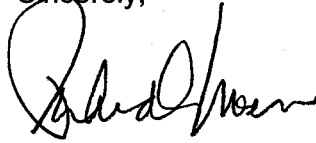
The licensee's initial investigation consisted of visual inspection of the spent fuel pool, review of vendor and licensee fuel and fuel shipping records, and personnel interviews. Since then, the licensee has retrieved records and reviewed potentially relevant documentation, such as vendor fuel reconstitution records, spent fuel pool maps, control room logs, radiation work permits, material transfer forms, and waste shipment records. The licensee intends to conduct additional spent fuel pool visual inspections and personnel interviews and have further communications with representatives from the licensed radioactive waste facilities in Barnwell, South Carolina, and Hanford, Washington.

The U.S. Nuclear Regulatory Commission (NRC) staff has closely monitored the licensee's investigation since the licensee formally reported to the staff by telephone on December 14, 2000, that it could not locate the two fuel rods. In addition, the NRC staff has discussed the event with individuals representing the States of South Carolina and Washington, which have possible involvement as Agreement States, and will continue to engage them in the event follow up.

In closing, let me emphasize that I share your concerns regarding this issue. Because of the potential health and safety implications, the NRC views the control of spent nuclear fuel to be of great importance. At this point, it is highly likely that the two missing fuel rods are either still located in the Millstone 1 spent fuel pool, or are buried at a licensed radioactive waste disposal site, thereby posing little or no threat to public health and safety. However, the NRC will closely monitor and evaluate the licensee's response to this event to assess actions to be taken to preclude future similar events. If the missing fuel rods are buried at a low-level waste disposal site, we will assess what corrective actions may be required.

If you have further comments or questions, please contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Richard A. Meserve", written in a cursive style.

Richard A. Meserve

Enclosure: Questions and Answers

Questions and Answers

- Q. "What Commission requirements govern the storage of spent fuel at nuclear power plants?"
- A. NRC requirements governing the monitoring, inventory and record keeping for storage of spent fuel at nuclear power plants are provided in Title 10 of the Code of Federal Regulations (10 CFR), Part 70, "Domestic Licensing of Special Nuclear Material," and in particular Section 70.51, "Material balance, inventory, and records requirements." The requirements that address the manner in which the fuel is stored are provided in 10 CFR Part 50 Appendix A, 10 CFR 50.68, 10 CFR Part 72, and the specific license for the facility.
- Q. "What procedures and policies are licensees required to follow to verify that no material is lost, stolen, or diverted?"
- A. In accordance with 10 CFR 70.51(c), a power reactor licensee is required to establish, maintain, and follow written material control and accounting procedures that are sufficient to enable the licensee to account for the special nuclear material (SNM) in its possession.

In addition, in accordance with 10 CFR 70.51(d), a power reactor licensee is required to conduct a physical inventory of all SNM in its possession at intervals not to exceed 12 months.

The licensee is also required to maintain records on the inventory (including location), disposal, and transfer of all SNM, which includes plutonium, uranium-233 (U-233), and uranium enriched in the isotopes U-233 or U-235. According to the requirements of 10 CFR 70.51(b)(5), the licensee must retain records of transfer from the facility for the life of the license, but may dispose of material acquisition and physical inventory records three years after the transfer is made.

Further, pursuant to the requirements of 10 CFR 70.54(a) and 74.15(a), the licensee must submit a Nuclear Material Transaction Report to the Nuclear Material Management and Safeguards System (NMMSS), operated for both NRC and the Department of Energy, every time its facility transfers (or receives) SNM.

Finally, in accordance with 10 CFR 70.53(a)(1) and 74.13(a)(1), at least twice a year, the licensee must submit material balance reports concerning SNM received, produced, possessed, transferred, consumed, disposed of, or lost, and an inventory composition report to NMMSS. NMMSS reconciles each licensee's report with a report generated from NMMSS and requests investigation of any differences. NRC participates in reconciliations when a reconciliation cannot be accomplished by NMMSS and the reactor licensee. The NMMSS is discussed further in a subsequent response.

Enclosure

Q. "What fines or other penalties can the Commission impose if a licensee fails to adhere to such requirements?"

A. Violations of NRC regulations are subject to civil enforcement action and may also be subject to criminal prosecution. After identifying an apparent violation, the NRC makes an assessment in accordance with its Enforcement Policy.

Three primary enforcement sanctions are available: a Notice of Violation (NOV), a civil penalty, or an order. An NOV identifies a requirement and how it was violated, and formally cites the violation pursuant to 10 CFR 2.201, "Notice of violation;" it normally requires a written response. A civil penalty is a monetary fine imposed under the authority of Section 234 of the Atomic Energy Act of 1954, as amended (AEA). The AEA allows for penalties of up to \$100,000 per violation per day. The Debt Collection Improvement Act of 1996 raised the amount to \$110,000. An order modifies, suspends, or revokes a license or requires specific actions be taken by a licensee or a person. The Commission's authority to issue orders under Section 161 of the AEA is broad and covers any area of licensed activity that affects the public health and safety. NOVs and civil penalties may be issued for violations. Orders may be issued for violations or because of public health or safety issues.

Q. "Does the Commission intend to impose any such fines or penalties in this case?"

A. The NRC staff's inquiry into the circumstances leading to the loss of accountability is still ongoing. When complete, we will apply the Enforcement Policy to determine the appropriate enforcement action. The NRC staff notes, however, that any civil sanction may be limited by the statute of limitations, 28 U.S.C. § 2462, "Time for commencing proceedings," which is applicable to the NRC as well as other government agencies.

Q. "According to the aforementioned article in *The Day*, Leon J. Olivier, a senior vice president and chief nuclear officer at Millstone [1], and Bruce Kenyon, president of generation for Northeast Utilities, indicated that they had no knowledge of any other commercial nuclear plant that had misplaced spent nuclear fuel. Is the Commission aware of any other instances of lost or misplaced spent fuel?"

A. The other instances the Commission is aware of are as follows:

In 1990, a nuclear power plant shipped one more irradiated fuel rod than planned. The licensee discovered the discrepancy in 1991 and notified the NRC and the NMMSS, and corrected its records. The extra rod was protected along with the rest of the shipment.

On several occasions, licensees have reported "lost" or "missing" spent fuel, but in each case the spent fuel was known to be contained in the reactor coolant system, the spent fuel pool, or a refueling pathway, and thus was secure within the facility.

- Q. "Will the Commission require its licensees to review the inventories of all other nuclear power facilities in the U.S. to determine if other discrepancies exist?"
- A. NRC is closely monitoring the licensee's investigation to determine exactly what happened to the two Millstone 1 fuel rods. Following the completion of the NRC's inquiry, we will consider whether industry-wide generic action is warranted.
- Q. "Are utilities required to periodically review their inventories to find whether these types of discrepancies exist?"
- A. A power reactor licensee is required to conduct a physical inventory of all SNM in its possession at intervals not to exceed 12 months in accordance with 10 CFR 70.51(a)(8) and 10 CFR 70.51(d) .
- Q. "How can we know whether the missing rods at Northeast Utilities are an isolated incident or evidence of a more widespread phenomenon?"
- A. Licensee SNM inventory and transaction data are required to be reported to the National Nuclear Material Accounting Database via the NMMSS. The NMMSS maintains information on facility inventories, shipper-receiver differences, and inventory differences. The transaction information is used to match reported shipments with corresponding receipts. Twice a year, licensees reconcile facility records with the NMMSS information to identify anomalies in facility records. The NRC staff is still investigating why the Millstone 1 anomaly was not identified in 1980 or in later years by the licensee or NMMSS. Based on the results of our investigation, we may elect to require additional actions at other facilities.
- Q. "According to the article in *The Day*, radioactive waste at the facilities in South Carolina and Washington 'is not buried in a precise location.' Why not?"
- A. Regulations provided in 10 CFR 61.80, "Maintenance of records, reports, and transfers," require that the licensee record and document, among other things, the quantity of radioactive wastes in a shipment and the location of disposal in the site. Since South Carolina and Washington are Agreement States, the low-level waste disposal facilities in these States are regulated by State agencies. Both States have adopted regulations compatible with 10 CFR Part 61, including provisions for recording the location of disposals.

The regulations at 10 CFR Part 61 became effective in January 1983 and the State regulations were adopted subsequent to 1983. If the Millstone 1 fuel rods were shipped to either of these sites before 1983, the specific requirements of those regulations would not have been applicable. However, according to officials from South Carolina and Washington, the locations of disposed wastes were being recorded during the early 1980s. Thus, both facilities could retrieve waste, if necessary, because of the existence of records for the location of specific disposals.

Q. "Do these sites record at least the quantity of the materials that are buried? Why wouldn't these sites require a knowledge of the inventories on their premises?"

A. The quantities of radioactive materials are and must be recorded. Thus, the inventories are required to be known. The records for disposal are based in part on the shipping manifest provided to the waste storage facility by the licensee shipping the material.

Q. "What are the potential public health consequences of storing high-level waste like the spent fuel rods at low-level radioactive waste facilities?"

A. Currently there is no evidence that the Millstone 1 spent fuel rods were disposed of at a low-level waste site. The Commission's regulations in 10 CFR Part 61 (and the compatible regulations in the States of Washington and South Carolina) rely on a combination of 100 years of active institutional controls (to control land use at the facility), government ownership of land, and engineered barriers or depth of burial to isolate highly radioactive wastes from people. However, because the fuel rods remain highly radioactive longer than low-level waste, there is a potential for higher doses to possible intruders after the Part 61 controls are no longer in effect. There is no present hazard from the disposal of the two fuel rods from Millstone 1 at a low-level waste facility.

Another potential hazard is that radionuclides released from the fuel rods could migrate into the groundwater, eventually exposing members of the public to radiation. The licensee estimates the amount of radioactivity in the fuel rods to be approximately 300 curies. (Although we have not independently verified that estimate, it appears to be reasonable.) This amount of radioactivity is a tiny part of the total inventory of several million curies at each site that must already be isolated to protect the public health and safety. Thus, the incremental effect of the fuel rods on public health and safety from groundwater would be small. The hazard would depend on such factors as the specific radionuclides in the waste and site specific characteristics, such as how fast the groundwater moves.

Q. "What are the consequences for the workers at those facilities?"

A. Radiation exposure of workers at the disposal facilities are governed by radiation protection programs. The doses they receive from radioactive materials are continuously monitored to ensure that the doses are within regulatory limits. Both facilities routinely dispose of some low-level waste with relatively high radiation levels and have procedures in place for ensuring that doses to workers are not only within the regulatory limits but as low as is reasonably achievable. Therefore, we anticipate no significant consequences for the workers.

Q. "What penalties are normally imposed on licensees for sending materials to an improper facility?"

A. The penalties for transporting or disposing of materials improperly are based on the circumstances of each case. The Commission considers the quantity and radioactivity of the materials, the exposure risk to workers or members of the public, and the effect on the environment. The Commission also considers the underlying causes for the violation and the licensee's efforts to identify and correct the problem.

Q. "Does the Commission intend to impose any fines or other penalties in this case?"

A. As noted previously, the NRC staff's inquiry is still ongoing. If the staff determines that the SNM was transported or disposed of improperly by the licensee, the staff will apply the Enforcement Policy to determine the appropriate enforcement action. The NRC staff notes, however, that any civil sanction may be limited by the statute of limitations, 28 U.S.C. § 2462, "Time for commencing proceedings," which is applicable to the NRC as well as other government agencies.

Q. "According to the NRC Weekly Report, there is a box in the spent fuel pool at Millstone 1 that workers were not able to examine without assistance from GE [General Electric]. What sort of equipment and expertise was required from GE to do this examination?"

A. The box referred to in the NRC Weekly Report is an in-pool GE storage container, designated SRP-2D, for segmented test fuel rods. Segmented test rods were used at Millstone 1 in the 1970s and early 1980s as part of a joint GE-utility program to evaluate fuel performance. The SRP-2D container is constructed like a fuel bundle, with a lower tie plate, an upper tie plate, and spacers. A bundle channel encases the SRP-2D assembly to provide torsional support, preventing flexing during handling.

Because the channel housing would have to be removed and the upper tie plate may have to be removed to see if the missing fuel rods had been placed in SRP-2D, the licensee contracted with qualified GE personnel experienced in bundle disassembly activities to perform the inspection. Anticipating that special tools might be necessary to disassemble the container, the licensee also contracted with GE to provide those tools.

Q. "Why are those resources and expertise not located at the Millstone [1] facility?"

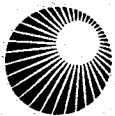
A. Millstone 1 employs personnel who are qualified to perform fuel handling activities, including dechanneling. However, bundle disassembly activities, such as upper tie plate removal, are not routine operations and are not normally performed by station personnel. GE personnel performed the last bundle disassembly activities at Millstone 1 in the early 1980s. The licensee decided it was safer to use experienced GE personnel for the recent storage container examination. The special tools (which were in fact not required for the examination) are used too infrequently to justify their purchase.

Q. "What assurances can the Commission provide that the spent fuel rods have not been stolen?"

A. The very high radiation level of the material makes theft difficult, dangerous, and very unlikely. The radiation levels also make the material of limited or no economic value. Moreover, the amount and chemical form of the fissile material contained in the two spent fuel rods make it unlikely, in our judgment, that the rods could be used to assist in the manufacture of a weapon. Had a theft occurred for the purpose of terrorism or radiological sabotage, it would be expected that such a threat would have materialized in the 20 years over which the discrepancy is believed to have existed. No such threat has been identified.

- Q. "What would be the proliferation consequences of the diversion of this material?"
- A. The two fuel rods pose no risk of proliferating nuclear weapons. The uranium (U-235) in the fuel rods is low-enriched uranium (2.44%). The amount of U-235 in each rod is about 50 grams. The plutonium created in each rod during its time in the reactor core is estimated to be approximately 20 grams. In general, the NRC considers proliferation consequences to be small for SNM quantities less than 5000 grams of highly enriched uranium (>20% U-235) or 2000 grams of plutonium, or a combination thereof (10 CFR 73.2, "Special nuclear material of low strategic significance").
- Q. "I would like to receive a copy of the written report that the licensee is required to file with the Commission 30 days after making the initial telephone report of the discovery, pursuant to 10 CFR 20.2201."
- A. A copy of the licensee's report is attached.

Attachment:
Licensee Event Report



**Northeast
Nuclear Energy**

Rope Ferry Rd. (Route 156), Waterford, CT 06385

Millstone Nuclear Power Station
Northeast Nuclear Energy Company
P.O. Box 128
Waterford, CT 06385-0128
(860) 447-1791
Fax (860) 444-4277

The Northeast Utilities System

January 11, 2001
B18309

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001


Subject: Millstone Nuclear Power Station, Unit No. 1, Docket No. 50-245
Licensee Event Report (LER) 2000-02-00

This letter forwards Licensee Event Report 2000-02-00 (Attachment 1) and is submitted pursuant to 10CFR20.2201(b).

If you have any questions regarding this letter, please contact Mr. Bryan S. Ford at (860) 437-5895.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY



Bryan S. Ford
Director Decommissioning

cc: H. J. Miller, Region I Administrator
J. B. Hickman, NRC Senior Project Manager, Millstone Unit No. 1
T. J. Jackson, NRC Region 1

Director
Bureau of Air Management
Monitoring and Radiation Division
Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

LICENSEE EVENT REPORT (LER)(See reverse for required number of
digits/characters for each block)

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

FACILITY NAME (1)

Millstone Nuclear Power Station Unit 1

DOCKET NUMBER (2)

05000245

PAGE (3)

1 OF 6

TITLE (4)

Fuel Rod Accountability

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
11	16	2000	2000	-- 002 --	00	01	15	2001	FACILITY NAME	DOCKET NUMBER
OPERATING MODE (9)		N/A		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)						
POWER LEVEL (10)		0		X 20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
				20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
				20.2203(a)(2)(i)		20.2203(a)(3)(iii)		50.73(a)(2)(iii)		73.71
				20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
				20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
				20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Bryan Ford, Decommissioning Director	(860) 437-5895

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)

X YES (If yes, complete EXPECTED SUBMISSION DATE).	NO	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
			4	01	01

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

During a reconciliation and verification of the Millstone Unit 1 spent nuclear fuel records, Unit 1 personnel concluded that the location of two full-length irradiated fuel rods could not be determined, and was not properly tracked in the Special Nuclear Material (SNM) records. The records reconciliation and verification effort is part of ongoing decommissioning activities at Millstone Unit 1.

The two irradiated fuel rods are from fuel assembly MS 557, which was disassembled in 1972 for inspection. The two rods were displaced during the re-assembly of assembly MS 557 in 1974. Records indicate that in 1979 and 1980, the displaced rods were physically verified to be stored in a canister in the Spent Fuel Pool (SFP). The rods and canister are no longer in the SFP location documented in 1979 and 1980. Records retrieved to date do not document their relocation or disposition.

Due to the radiation levels associated with the fuel rods, it is only considered credible that they either remain stored in the SFP or they were shipped in a shielded cask to a facility licensed to accept radioactive material. Due to the controls in place at both Millstone and the facilities licensed to accept radioactive material, there is no undue risk to the health and safety of the public or plant and licensed facility workers.

The investigation into the location of the two fuel rods is ongoing.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET	LER NUMBER (6)				PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
Millstone Nuclear Power Station Unit 1	05000245	2000	-- 02 --	00	2 OF 6	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

I. Description of Event

During a reconciliation and verification of the Millstone Unit 1 spent nuclear fuel records, it was concluded that the location of two full-length irradiated fuel rods was not properly tracked in the Special Nuclear Material (SNM) records. The records reconciliation and verification effort is part of ongoing decommissioning activities at Millstone Unit 1. A condition report (CR) M1-00-0548 was written on November 16, 2000, documenting the issue. Table 1 provides a description of the fuel rods.

The two irradiated fuel rods are from fuel assembly MS 557, which was disassembled in 1972 for inspection. The two rods were displaced during the re-assembly of assembly MS 557 in 1974. Records indicate that in 1979 and 1980, the displaced rods were physically verified to be stored in a canister in the Spent Fuel Pool (SFP). The rods and canister are no longer in the SFP location documented in 1979 and 1980. Records retrieved to date do not document their relocation or disposition.

On December 14, 2000, Northeast Nuclear Energy Company (NNECO) notified the Nuclear Regulatory Commission (NRC) of the fuel rod accountability issue via telephone pursuant to the requirements of 10CFR20.2201(a)(ii) and 10CFR50.72(b)(2)(vi). Concurrently, NNECO notified the State of Connecticut.

II. Chronology

October 1972	Assembly MS 557 was disassembled by the fuel vendor to provide assembly components for analysis and testing.
May 1974	Assembly MS 557 was reassembled by the fuel vendor. Two rods were not replaced into the assembly.
1974 through 1984	The fuel vendor conducted a Segmented Test Rod (STR) Program that included shipping of irradiated, segmented (partial length) test fuel rods in a shielded cask to the vendor for analysis and evaluation. This program also resulted in the construction of a separate assembly (canister), SRP-2D to hold discharged segmented test rods as needed.
1978 through 1985	Work was performed in the SFP to process, consolidate and store miscellaneous irradiated components and instruments in cask liners.
March 1979	A SFP map dated March 13, 1979 identifies two rods in a canister located in the SFP.
May 1979	A reactor engineer requests that the onsite fuel vendor representative visually inspect the canister in the SFP and identify the two fuel rods utilizing the serial numbers. The vendor responds that their visual inspection of the rods and applicable fuel assembly records indicates that the two fuel rods are from assembly MS 557. The reactor engineer begins tracking these two rods on an inventory card in the Fuel Card Index.
April 1980	The fuel rods are noted on the SFP map of April 30, 1980 as located in a storage canister in the SFP.
September 1980	A SFP map dated September 18, 1980 no longer identifies the location of the fuel rods and canister.
1980 through 1990	Numerous shipments of miscellaneous irradiated components from the SFP occurred.
1990	An inventory list was completed in early 1990 and there was no indication of the canister or the two fuel rods.

LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET	LER NUMBER (6)				PAGE (3)
Millstone Nuclear Power Station Unit 1	05000245	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	3 OF 6	
		2000	-- 02 --	00		

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

November 16, 2000	The records reconciliation and verification effort identifies that the location of two full-length irradiated fuel rods was not properly reflected in Special Nuclear Material (SNM) records. Condition Report M1-00-0548 was initiated.
December 14, 2000	NNECO notified the Nuclear Regulatory Commission (NRC) of the fuel rod accountability issue via telephone pursuant to 10CFR20.2201(a)(ii) and 10CFR50.72(b)(2)(vi). Concurrently, NNECO notified the State of Connecticut.
December 20, 2000	The licensed facilities in South Carolina and Washington that receive radioactive waste material shipments from Millstone were contacted and informed about the fuel rod accountability issue.

III. Investigation

A response team was established and later augmented to locate the fuel rods. Due to the radiation levels associated with the fuel rods, the investigation focused on locating the rods either in the pool or at a facility licensed to accept radioactive material. Initial reviews of records and visual inspections of the most likely locations in the SFP have been performed. Selected visual inspections of the SFP were conducted assuming four possible scenarios: (1) the rods are still in their original canister, (2) the rods have been removed from the original canister and have been placed in a different canister, (3) the rods have been placed in a fuel assembly, or (4) the rods are stored in other available locations; e.g., empty fuel storage locations, control rod storage tubes, etc.

The following specific actions have been completed:

1. The visual inspection of assembly MS 557 indicates that it contains a dummy spacer capture rod and an empty hole in one tie rod location.
2. Two specific possible locations for the rods were identified and visually inspected: assembly (canister) SRP-2D and the fuel canister containing fuel assembly MS 508.
3. A visual inspection of accessible spent fuel pool locations was made with special camera equipment.
4. A review of selected vendor and licensee fuel records has been performed.
5. A review of selected vendor and licensee fuel shipment records has been performed. The record of shipments of irradiated fuel describe transfer of test rods to the vendor during the 1974-1984 time period. The vendor location noted on the shipping records was not capable of receiving full-length irradiated fuel rods during the 1974-1984 time period. Therefore, it is considered unlikely that the fuel rods were shipped to this vendor location.
6. Personnel interviews have been performed.
7. A radiological and criticality assessment of the two fuel rods was performed.
8. An independent review team has been established to assess completed actions and provide recommendations as the investigation continues.

The investigation is on-going and the investigation team is being augmented as needed.

IV. Health and Safety

An assessment of the contact radiation levels of the two fuel rods has been performed. Contact radiation levels were initially estimated to have been on the order of 8000R/hr in the early 1980's and approximately 1000R/hr today. Results of the detailed calculations revealed that doses were on the order of 1600R/hr in 1980 and 850R/hr in 2000. With these radiation levels, removal from the SFP, other than in a shielded cask would have triggered multiple plant radiation alarms. The possibility of theft or diversion of the two fuel rods is highly improbable due to the estimated radiation levels.

LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
Millstone Nuclear Power Station Unit 1	05000245	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	4 OF 6
		2000	- 02 -	00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

Two possible scenarios have been analyzed for health and safety:

1. Fuel rods remain on site.

A criticality calculation has shown that even with the rods inadvertently located next to the most reactive fuel assembly in the spent fuel pool, the geometric configuration is such that the local fuel assembly array, as well as the pool would remain below 0.90 K_{eff} sub-critical. If the rods remain in the SFP, they are stored safely with the other spent fuel and there is no undue threat to the health and safety of the public or plant workers. Further visual inspections of the SFP are planned.

2. Fuel rods were shipped off site.

If a shielded cask shipment occurred, it was shipped to a licensed facility, either as:

(a) Irradiated fuel to the fuel vendor; or

If the fuel rods have been sent to a licensed irradiated fuel vendor, they are being stored in accordance with the vendor's license requirements which are established to ensure that there is no undue risk to the health and safety of the public, environment and the worker. Further records review is ongoing.

(b) Irradiated waste to a licensed facility.

An initial review of shipping records indicates that the only facilities considered credible for receiving these rods as irradiated waste are the licensed radioactive waste disposal sites in the States of Washington and South Carolina.

During shipment of these rods in a shielded cask, the general radiation profiles for the two fuel rods would have been within the limits established for transportation to these licensed facilities under existing DOT, NRC and States of Washington and South Carolina regulations. Therefore, due to the controls in place during the shipping of radioactive material to these licensed facilities, there is no undue threat to the health and safety of the public, resulting from the possible shipment of these fuel rods.

An initial review of these facilities has indicated that although these facilities are not licensed to accept spent nuclear fuel, they are authorized to receive and possess source material and special nuclear material. This review also indicated that the total activity and volume associated with the rods is a small fraction of the total activity and volume accepted at these sites. In addition, a criticality evaluation of the two fuel rods was performed. In the optimum (or worst case scenario) configuration, the criticality evaluation of the two rods with an enrichment of 2.44 w/o % at zero burn-up, with a water reflector, indicates that the fuel would be substantially sub-critical. Therefore, due to the controls in place at these facilities licensed to accept radioactive material, there is no undue threat to the health and safety of the public, or workers at these facilities, resulting from the possible shipment and receipt of these fuel rods.

Further records review is ongoing.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET	LER NUMBER (6)				PAGE (3)
Millstone Nuclear Power Station Unit 1	05000245	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	5 OF 6	
		2000	--	02	--	00

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

V. Cause of Event

NNECO can not provide the apparent cause for this event at this time. The investigation is on-going.

VI. Independent Assessment

The Independent Review Team that is augmenting the investigation has performed an initial assessment. They have independently determined that:

- They concur with the information and data reviewed to date that there is no undue risk to the health and safety of the public, plant workers or licensed facility workers.
- Evidence to date does not strongly support one scenario over the other; i.e., that the fuel rods are in the SFP or have been shipped to a licensed facility.

VII. Ongoing Actions

The investigation and the following actions are ongoing:

1. The establishment of an enhanced project team.
2. The performance of additional SFP visual inspections.
3. The continuation of records retrieval and review of relevant documentation (e.g., SFP maps, control room logs, vendor fuel reconstitution records, radiation work permits, waste shipment records, and material transfer forms).
4. The conduct and documentation of additional personnel interviews.
5. Ongoing communications and notifications to the licensed facility located on the Hanford Reservation in the State of Washington and the licensed facility located at Barnwell in the State of South Carolina.

VIII. Future Reports

In accordance with 10CFR20.2201(d), subsequent to this written report, additional substantive information will be reported within 30 days of discovery of such information. A Supplemental Report will address the following additional issues:

1. Circumstances under which the rods were lost.
2. Statement of disposition, or probable disposition of the rods.
3. Actions that have been taken and will be taken to recover the rods.
4. Description of procedures or measures that have been, or will be taken to prevent recurrence.

LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET	YEAR	LER NUMBER (6)			PAGE (3)
Millstone Nuclear Power Station Unit 1	05000245	2000	SEQUENTIAL NUMBER	REVISION NUMBER	6 OF 6	
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TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

Table I – Fuel Rods Description

Type of Special Nuclear Material:	One GE 7D Tie rod and One GE 7D Spacer Capture Rod
Material:	Uranium dioxide initially enriched to 2.44% in Zircaloy 2 cladding
Length of Fuel Rods:	158 inches
Fuel Rod Diameter:	0.570 inches
Total Uranium in the 2 Fuel Rods:	7732.0 grams (year 2000)
Total Uranium₂₃₅ in the 2 Fuel Rods:	101.4 grams (year 2000)
Total Plutonium in the 2 Fuel Rods:	40.2 grams (year 2000)
Total Fissile Plutonium in the 2 Fuel Rods:	32.8 grams (year 2000)
Activity Level:	2.591 X 10 ² Ci (year 2000)
Average Burnup of Assembly MS 557	9011 MWD/MTU
Effective Full Power Days (EFPD):	508 EFPD